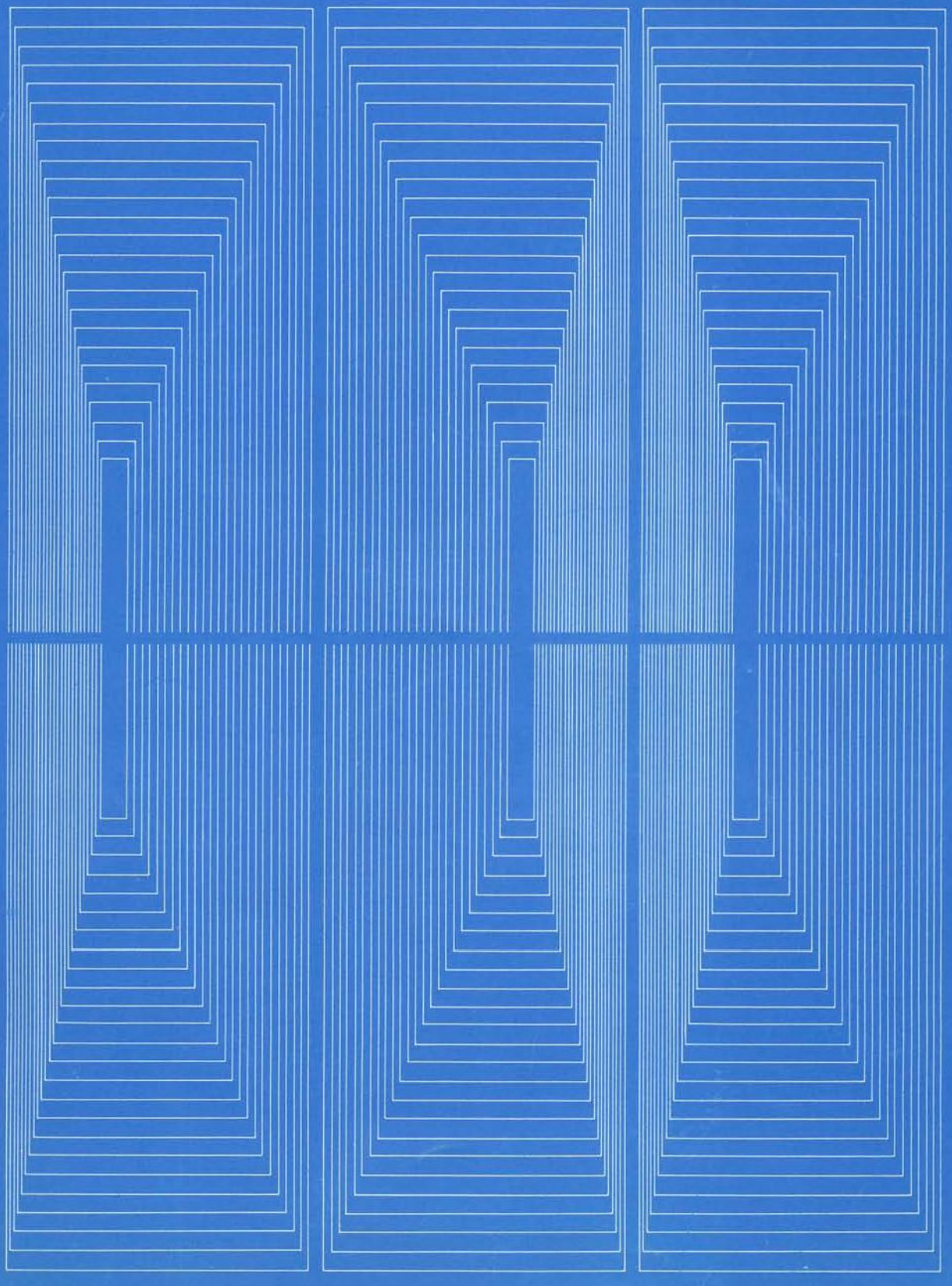
# OLYMPUS POLARIZING MICROSCOPE

# INSTRUCTION MANUAL

# OLYMPUS BHTP



This instruction manual has been written for the use of the Olympus Polarizing Microscope Model BHTP. This manual should be read carefully so that the user can gain familiarity with the microscope in order to ensure optimum performance.

## IMPORTANT

Observe the following points carefully:

OPERATION

1. Always handle the microscope with the care it deserves, and **avoid abrupt motions.**

2. Avoid exposure of the microscope to **direct sunlight, high temperature*** and **humidity, dust** and **vibration.**
   *If the microscope is used in ambient temperature higher than 40°C (104°F), the heat may cause difficulties in the instrument.

3. **Use the tension adjustment ring only for altering the tension of the coarse adjustment.** Do not twist the two coarse adjustment knobs in the opposite directions simultaneously, which might cause damage.

4. Ascertain that **the line voltage selector switch** on the base plate is set to conform with the local mains voltage.

MAINTENANCE

1. Lenses must always be kept clean. Fine dust on lens surfaces should be blown or wiped off by means of an air blower or a clean brush. Carefully wipe off oil or fingerprints deposited on the lens surfaces with gauze moistened with a small amount of xylene, alcohol or ether.

2. Do not use organic solutions to wipe the surfaces of various components. Plastic parts, especially, should be cleaned with a neutral detergent.

3. **Never disassemble** the microscope for repair. Only authorized Olympus service personnel should make repairs.

4. The microscope should be stored in its container immediately after use. If this is not possible, it should be covered with a vinyl dust cover. It is best to keep objectives and eyepieces in a desiccator, containing desiccants.

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# I. STANDARD EQUIPMENT

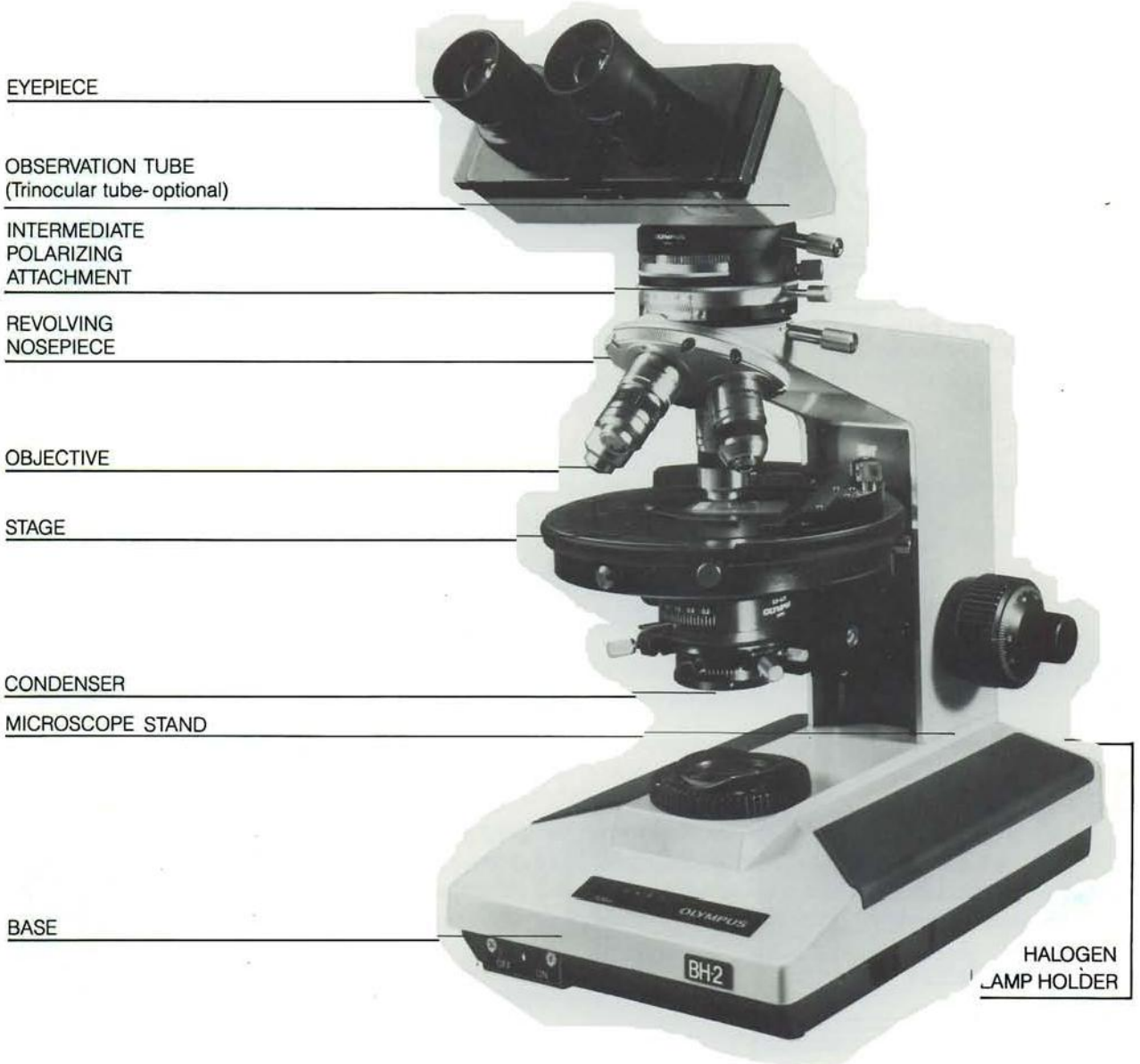
| Catalog # | Component | | Model | BHTP 100 | BHTP 200 |
|---|---|---|---|---|---|
| BHT-001 | Microscope stand (with Allen wrench, KB-4 filter, immersion oil, vinyl dust cover and line cord, one each) | | BHT-F | 1 | 1 |
| 3-LC405 | Polarizing observation tubes | Binocular tube (with orientation plate) | BH2-Bi30 | 1 | 1 |
| P-0510 | Quadruple revolving nosepiece | | BH-PRE | 1 | 1 |
| P-L0501 | Intermediate polarizing attachment (with pin hole cap) | | BH2-PA | 1 | 1 |
| 4-LB751 | Centerable circular stage (with stage plate, centering knobs, and stage clips, paired) | | BH2-SRG | 1 | 1 |
| 5-LB402 | 20 watt halogen lamp holder | | BHT-LS20H | 1 | 1 |
| 8-6405 | Pre-centered halogen bulbs 6V 20W | | 6V 20W | 2 | 2 |
| 6-P609 | Abbe polarizing condenser | | BH2-POC | 1 | 1 |
| 1-LB223<br>1-LB233<br>1-LB251 | Strain Free Objectives | PO-D Ach. 4X<br>PO-D Ach. 10X<br>PO-D Ach. 40X (spring) | (Set of 3) | 1 | — |
| 1-LB520<br>1-LB530<br>1-LB550 | | PO-D Plan 4X<br>PO-D Plan 10X<br>PO-D Plan 40X (spring) | (Set of 3) | — | 1 |
| 2-LC322 | Eyepieces | WK 10X | | 1 | 1 |
| 2LB-323 | | WK - 10XM (Cross Hair and Scale) | | 1 | 1 |

□ OPTIONAL ACCESSORIES:

| | |
|---|---|
| P-0511 | Berek compensator AH-CTP-2 |
| P-0307 | Quarter wave plate AHTP-147-2 |
| P-0306 | Full wave plate AHTP-530-2 |
| 3LC553 | Trinocular tube BH2-TR30 |

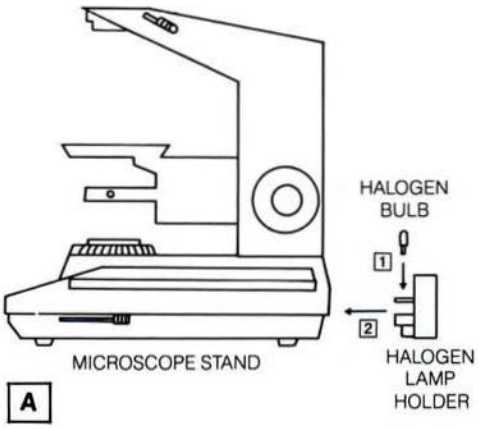
# II. NOMENCLATURE

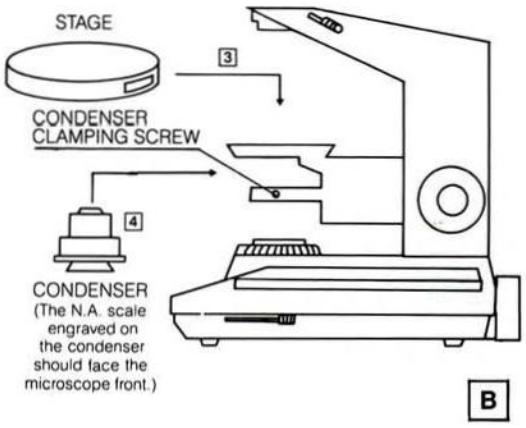
The Model BHTP consists of various components as shown in the photo below:

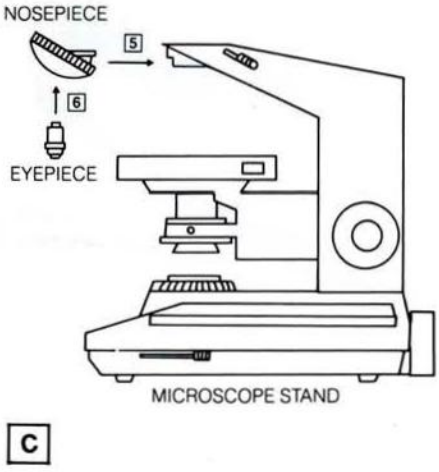


## III. ASSEMBLY

This picture illustrates the sequential procedure of assembly. The numbers indicate the order of assembly of various components. Remove dust caps before mounting components. Take care to keep all glass surfaces clean, and avoid scratching the glass surface.



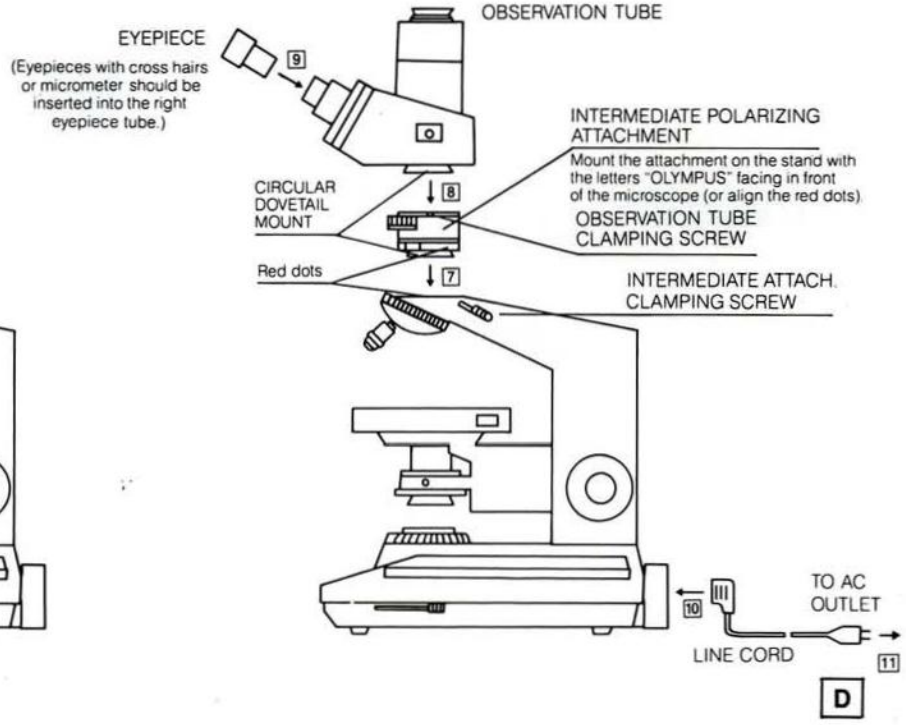



Fig. 1

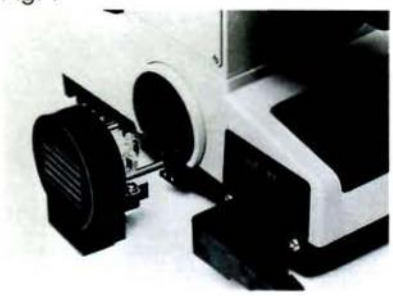


Fig. 2

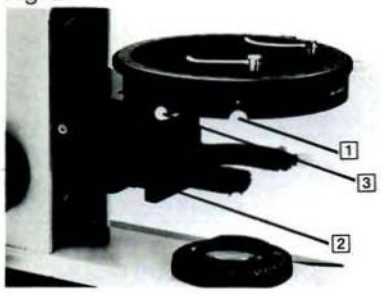



Fig.3

Fig. 4

**Explanations in detail**

1. MOUNTING THE HALOGEN BULB
   Gently insert the two fine prongs of the halogen bulb into the small holes of the lamp holder. Avoid fingerprints on the bulb. Wipe the bulb, if necessary.

2. ATTACHING THE LAMP HOLDER (Fig. 1)
   Fit the lower prongs of the lamp holder and the heavier side prongs of the lamp holder into the openings at the lower back of the base of the microscope.

3. MOUNTING THE STAGE (Fig. 2)
   1) Rack down the stage dovetail [2].

   2) Fit the stage carefully onto the dovetail. The Olympus nameplate should face the user. The two stage centering screws [1] should be angled toward each other; one to the left of center, the other to the right of center.

   3) Tighten the stage fastening screw [3]. This screw will be found on the user's left at a right angle to the body of the microscope.

4. MOUNTING THE CONDENSER
   Loosen the condenser clamping screw. Slide the condenser in, aperture scale facing forward. Tighten the clamping screw.

5. MOUNTING THE REVOLVING NOSEPIECE
   1) Loosen the nosepiece clamping screw [1] (Fig. 3)

   2) Aligning the nosepiece dovetail slide [2] to the mounting block, push in the nosepiece slowly all the way.

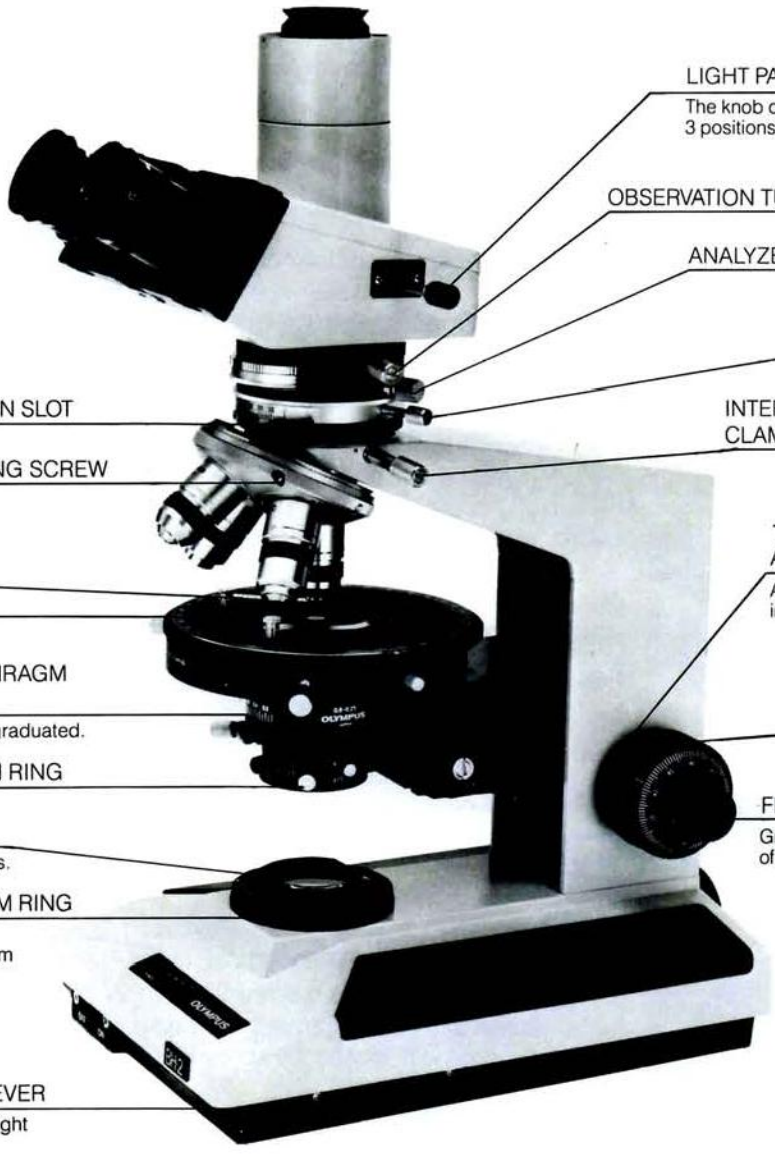
   ★ Do not tilt or lock the nosepiece while inserting into the mounting block.

6. MOUNTING THE INTERMEDIATE POLARIZING ATTACHMENT (Fig. 4)
   1) Loosen the clamping screw [1] fully. Pull spring-loaded clamping screw [1]. This will cause the locating pin [2] to withdraw. (Fig. 4) If the pin does not, loosen the screw further until the pin withdraws.

   2) With clamping screw [1] pulled out, insert the circular dovetail of the intermediate attachment into the ring dovetail.

   3) Tighten the clamping screw.

# IV. IDENTIFICATION AND FUNCTION OF VARIOUS COMPONENTS



LIGHT PATH SELECTOR KNOB
The knob can be operated in 3 positions to deflect the light as desired.

OBSERVATION TUBE CLAMPING SCREW

ANALYZER POSITIONING SCREW

ANALYZER ROTATION AND PULLOUT SCREW

TEST PLATE INSERTION SLOT

INTERMEDIATE ATTACHMENT CLAMPING SCREW

OBJECTIVE CENTERING SCREW

TENSION ADJUSTMENT RING
Arrow mark indicates increase in coarse adjustment tension.

STAGE CLIP

STAGE
Rotatable 360°.

APERTURE IRIS DIAPHRAGM LEVER
Numerical aperture scale graduated.

COARSE ADJUSTMENT KNOB

POLARIZER ROTATION RING

FINE ADJUSTMENT KNOB
Graduated in increments of 2μ.

FILTER MOUNT
Accepts 45mm-diam. filters.

FIELD IRIS DIAPHRAGM RING
Arrow mark ✲ → O indicates increase in diaphragm diameter.

SLIDING CONTROL LEVER
For continuously variable light intensity.

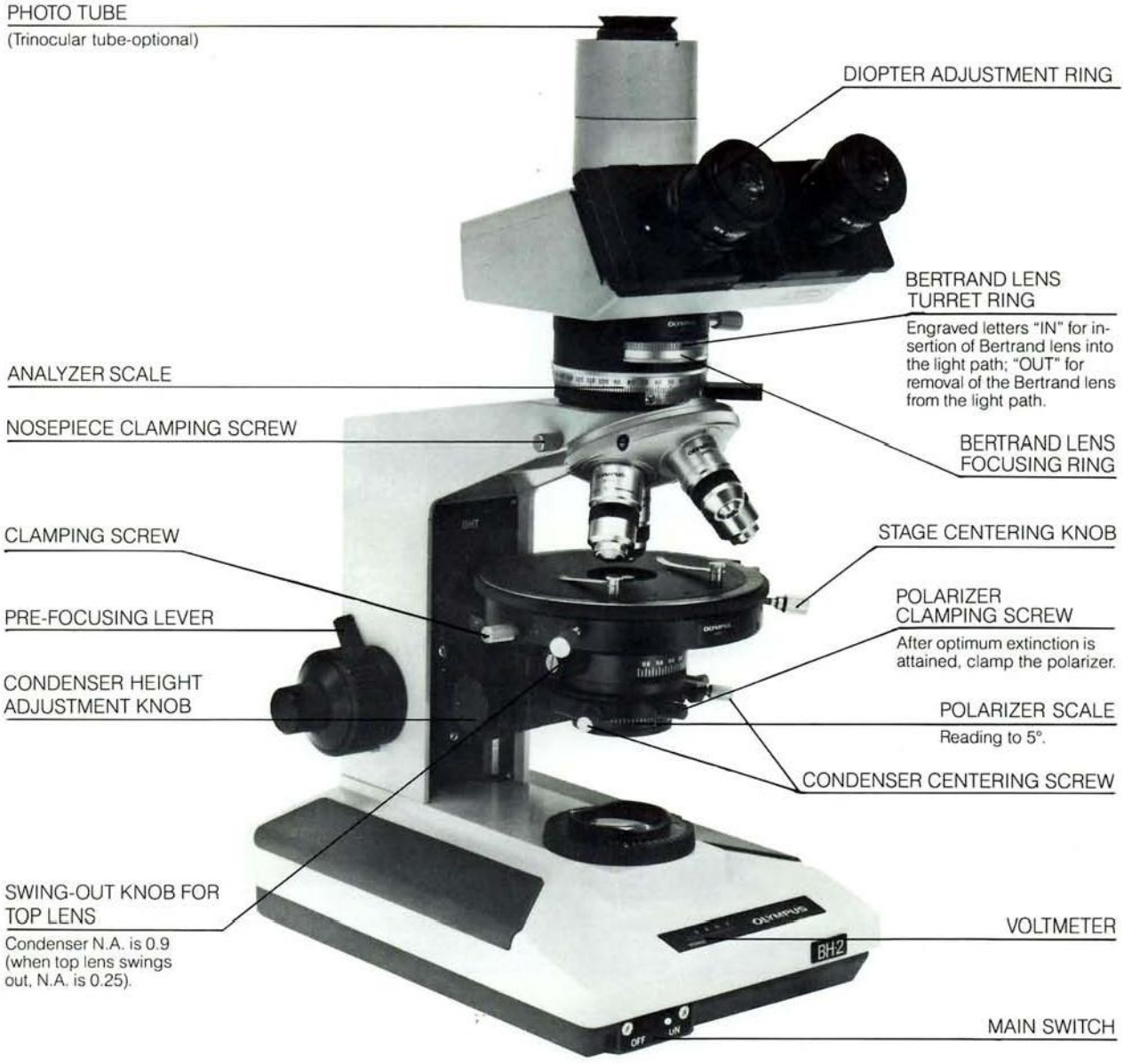
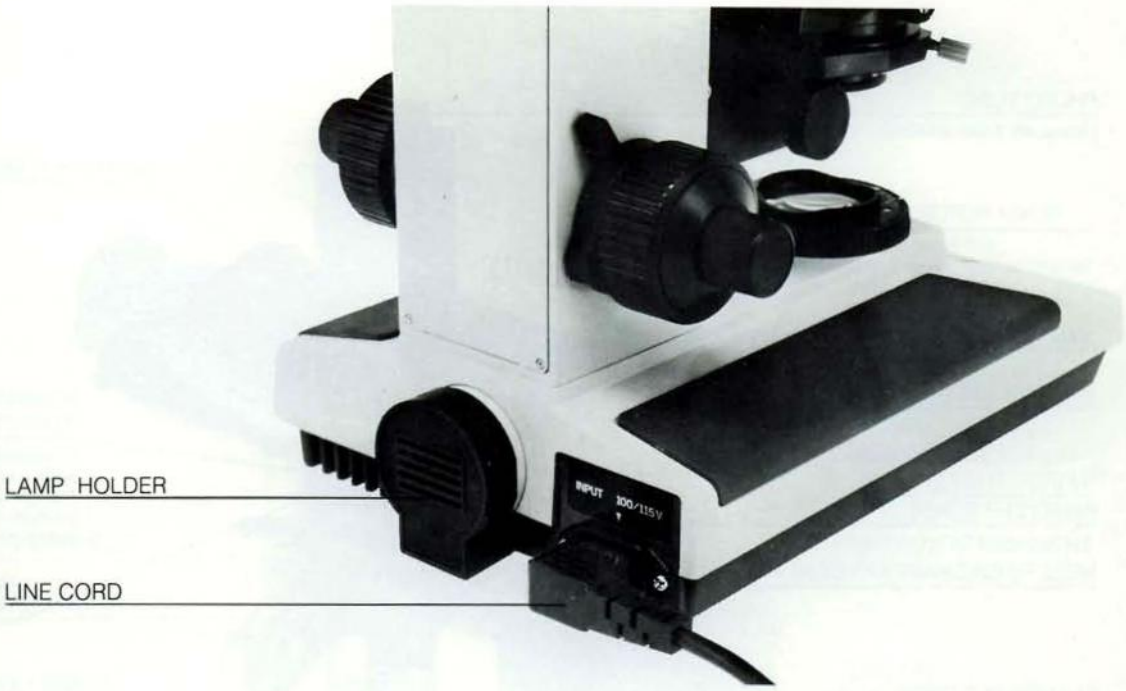


PHOTO TUBE
(Trinocular tube-optional)
DIOPTER ADJUSTMENT RING
BERTRAND LENS TURRET RING
Engraved letters "IN" for insertion of Bertrand lens into the light path; "OUT" for removal of the Bertrand lens from the light path.
ANALYZER SCALE
NOSEPIECE CLAMPING SCREW
BERTRAND LENS FOCUSING RING
CLAMPING SCREW
STAGE CENTERING KNOB
POLARIZER CLAMPING SCREW
After optimum extinction is attained, clamp the polarizer.
PRE-FOCUSING LEVER
CONDENSER HEIGHT ADJUSTMENT KNOB
POLARIZER SCALE
Reading to 5°.
CONDENSER CENTERING SCREW
SWING-OUT KNOB FOR TOP LENS
Condenser N.A. is 0.9 (when top lens swings out, N.A. is 0.25).
VOLTMETER
MAIN SWITCH
OLYMPUS
BH2
OFF
ON


LAMP HOLDER
LINE CORD
INPUT 100/115V

## Summary of Putting the Microscope in Operation

## Model BHTP

A. Match the line voltage selector switch to local mains voltage (see page 10).

B. Switch on the light source.

C. Place a specimen slide on the stage.

D. Turn the Bertrand lens out and pull analyzer from the light path.

E. Coarse focus with the 10X objective.

F. Make interpupillary and diopter adjustments (page 10).

G. Push analyzer in and set the analyzer to optimum extinction position (page 11).

H. Center the condenser (page 11).

I. Center the stage (page 12).

J. Center objectives other than 10X (page 13).

K. Swing in the desired objective.

L. Set the condenser, analyzer and Bertrand lens correctly according to your microscopic purpose (pages 15 and 16).

M. Fine focus.

N. Adjust aperture iris diaphragm and field iris diaphragm (page 14).

## Adjustment of Illumination System

| Microscopic application | Objective | Bertrand lens in intermediate polarizing attachment | Condenser top lens |
|---|---|---|---|
| Orthoscopic observation | 4X to 10X | OUT | OUT |
| | 20X to 100X | OUT | IN |
| Conoscopic observation | 20X to 100X | IN | IN |

Generally for biological use, however, remove the analyzer, Bertrand lens and test plates from the light path.

*Cut off this page at dotted line and put in on the wall near the microscope for use as a reminder of microscopic procedure.*

# V. OPERATION

Fig. 5

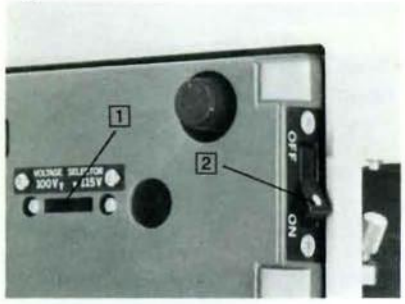



Fig. 6

Fig. 7

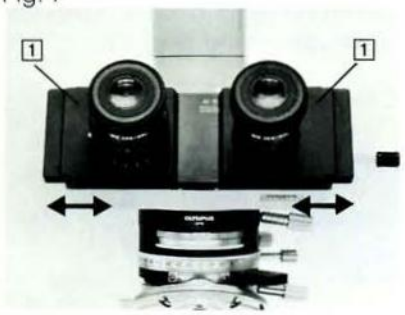



Fig. 8

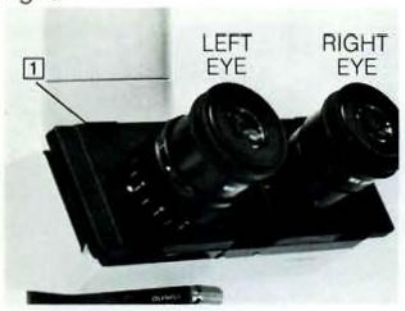
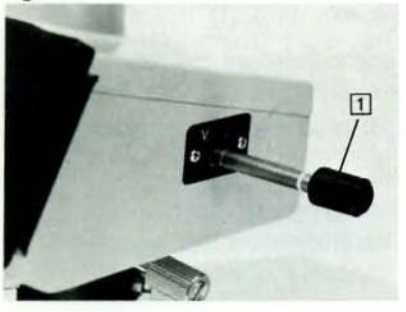



Fig. 9




### A. Switching on the Light Source

1. Ascertain that the voltage selector switch [1] is set to conform with the local mains voltage. (Fig. 5)
   If the switch is not correctly set, adjust it by means of the Allen wrench provided or a screwdriver.

2. Place the sliding voltage control lever on the right side of the microscope base to a position closest to you (low voltage position). Switch on the light source [2]. (Fig. 5)

   VOLTAGE ADJUSTMENT AND LIGHT INTENSITY

   As you push the control lever [1] in the direction of the arrow in order to obtain increasing intensity (Fig. 6), the LED readout [2] will display the lamp voltage.

### B. Observation Tube

1. INTERPUPILLARY DISTANCE ADJUSTMENT
   1) Click the 10X objective into position.
   2) Looking through the eyepieces with both eyes, adjust the interpupillary distance of the binocular tube by adjusting the knurled dovetail slides [1] of the right and left eyepiece tubes with both hands until perfect binocular vision is obtained. (Fig. 7)

2. DIOPTER ADJUSTMENT
   1) Look at the image through the right eyepiece with your right eye and focus on the specimen with the fine adjustment knobs.
   2) Next, look at the image through the left eyepiece with your left eye and rotate the diopter adjustment ring [1] to focus on the specimen without using the coarse and fine adjustment knobs. (Fig. 8)

LIGHT PATH SELECTION

The trinocular tube (optional) is provided with a light path selector knob 1 to direct the light to the observation tube and/or to the photo tube in 3 positions. (Fig. 9)

| Knob position | Pushed in all the way (V) | Pulled out halfway (C V) | Pulled out all the way (C) |
|---|---|---|---|
| Amount of light | 100% into binocular tube | 20% into binocular tube<br>80% into photo tube | 100% into photo tube |
| Application | "Crossed filter" observation | (1) Normal observation<br>(2) Photomicrography (focusing through the binocular tube) | Photomicrography |

An indicator plate is provided at the knob port to summarize the usage of the above table; it can be consulted before operating the knob.

V: Viewer (white letter)
C.V: Camera and viewer (yellowish green letters)
C: Camera (red letter)

The colors of the letters correspond with the color bands on the knob shaft.

Fig. 10

### C. Use of the Orientation Plate

The analyzer [1] built in the intermediate attachment should be adjusted for optimum extinction by means of the orientation plate provided, in the following steps.

1. Bring the 10X objective into the light path, and make sure that the red dots on both intermediate attachment and microscope stand are aligned. (Fig. 10)
2. Set both polarizer and analyzer at position "O" to attain the "crossed filter" position.
3. Place the orientation plate on the center of the stage.
4. Looking at the orientation plate through the eyepieces, rotate the stage (as you rotate the stage, the orientation plate darkens and brightens alternately) until it most darkens or attains the extinction position; then, touch up the position of the orientation plate manually so that the lower edge (fiducial line) of the orientation plate nears the cross line (X axis).
5. Disengage the analyzer [1] from the light path; this makes the field of view bright.
6. Loosening the observation tube clamping screw [2], rotate the observation tube slightly until the fiducial line of the orientation plate is in parallel with the cross line; then, reclamp the observation tube. (Fig. 10)

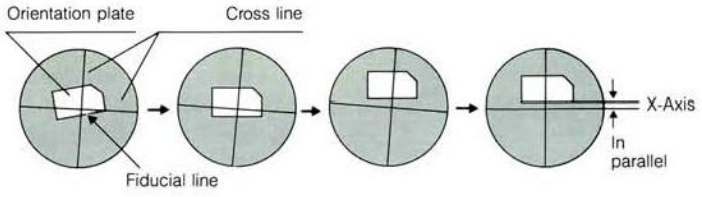
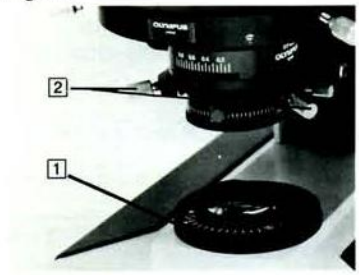



Fig. 11



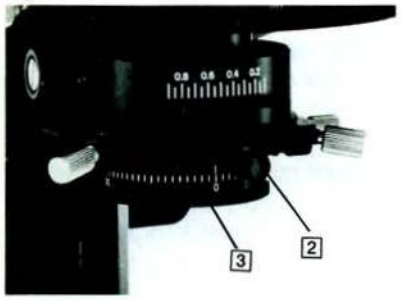

### D. Centering the Condenser

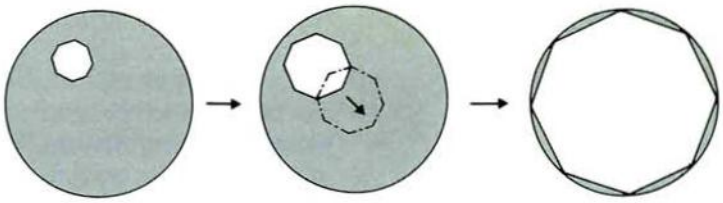
1. Bring the objective 10X into the light path.

   **If a specimen is placed on the circular rotatable stage without a mechanical stage it is recommended that the peripheries of the specimen be held with the stage clips provided.**
2. Swing in the condenser top lens, and bring the specimen into focus.
3. Stop down the field iris diaphragm [1]. A slightly blurred image of the field diaphragm can now be seen in the eyepiece. (Fig. 11)
4. Using the condenser knob, adjust the condenser height; focus the image of the field diaphragm onto the already focused specimen.

   **If the specimen slide is too thick, it is sometimes impossible to obtain a sharply-focused image.**
5. While widening the diameter of the field progressively by opening the field diaphragm in the base, use the condenser centering screws [2] to bring the field diaphragm image into the center of view. (Fig. 11)

Fig. 12



Field diaphragm almost closed and off center.

Field diaphragm opened and centered.

6. Push analyzer [1] into the light path (Fig. 10), and make sure that both polarizer and analyzer are set at position "O" to attain the "crossed filter" position. Then loosen the clamping screw [2] of the polarizer. (Fig. 12)

7. Remove the specimen from the light path so that a transparent area comes into the light path. Keeping the polarizer at the "O" position, rotate the polarizer rotation ring [3] until the optimum extinction is obtained, then clamp the ring. (Fig. 12)

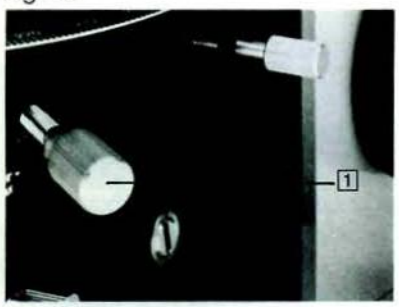
**Make sure that no compensator plate is engaged.**

**E. Centering the Stage**—See diagrams a, b, c

1. Place a specimen on the stage and focus it. Looking through the cross hairs eyepiece and the 10X objective, fix your eye on a particular, easily recognizable point of the specimen (point A). Bring this point (A) to the center of the cross hairs of the eyepiece.

2. Slowly rotate the stage, observing the path taken by point A as the stage is rotated 180° (point C) and then a complete turn, A▸B▸C▸D▸A. (See diagram a below). Visualize the imaginary center, E, of the circular path traversed by the specimen as the stage is rotated a complete turn. Rotate the stage 180° again so that recognizable point A is now at the position C (See diagram a below).*

Fig. 13




3. Using the **stage centering knobs** (Fig. 13 [1]), bring the recognizable point from position C to where the imagined Center E had previously been located. (See diagram b below).

4. Rotate the stage a complete turn while observing the recognizable point (A). If the movements effected in steps 2 and 3 were done perfectly, the recognizable point would now travel a circle with the crosshairs as the center of that circle. If it does not, repeat steps 2 and 3 until the stage centration is perfected. When done, **any** point of the specimen in view will, when the stage is completely rotated, travel in a circle with the cross hairs as the center of that circle. (See diagram c).

diagram a

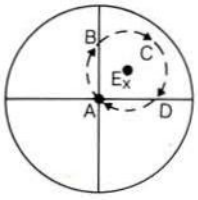



diagram b

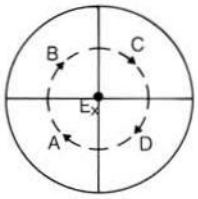
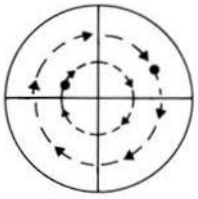



diagram c



*If the easily recognizable point A disappears from the field of view entirely when the stage is rotated 180°, the stage is significantly off-center. Proceed as follows: Visualize the imagined center E of the circle that point A appears to be traveling as the stage is rotated. **Using the stage centering screws,** move this imagined center E toward the intersection of the cross hairs. Rotate the stage completely again to see if point A stays in the field of view for the entire rotation. If not, repeat this procedure **using the stage centering screws** until point A (or any other easily recognizable point) stays in the field of view for a complete rotation (diagram a' and b'). Then proceed as in 2, 3 and 4, above.

diagram a'

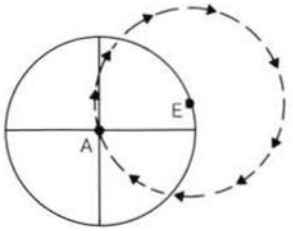
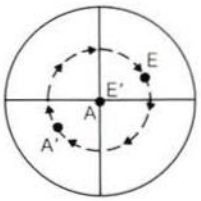



diagram b'




### F. Centering the Objectives

The centration of the objectives is needed for all the PO objectives except the PO 10X objective. The 10X objective is mounted on the nosepiece in the opening which does not have centering wrench screws immediately to the left and right of the 10X objective.

1. After completing centration of the stage as described above with use of the 10X objective, the centering wrenches must be inserted into the nosepiece on both sides of the objective to be centered. Rotate the nosepiece to bring this objective directly over the specimen being viewed.
2. Use a procedure similar to step 2 and 3 and 4 above. The centration now is accomplished by using the nosepiece centering wrenches, [1] **NOT the stage centering knobs,** to cause a specimen to move in a circle with the eyepiece cross hairs being the center of that circle. See diagrams a, b, c above.
3. This centration procedure must be repeated for each individual objective (other than the 10X) on the nosepiece **without using the stage centering knobs.**
4. Test the centration of the objective by observing a recognizable point in the specimen, e.g., near 6 o'clock position, and rotating the stage to complete the circle. The specimen should move to 9 o'clock, 12 o'clock, 3 o'clock, and back to 6 o'clock if the centration is accurate (See diagrams d and e below).

Fig. 14

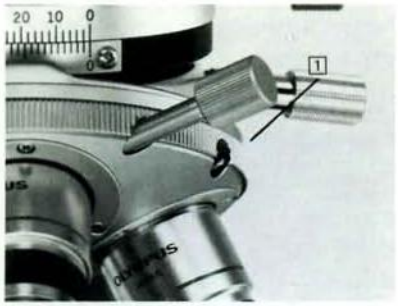



diagram d

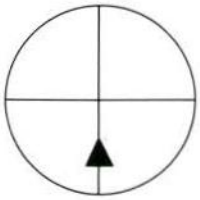
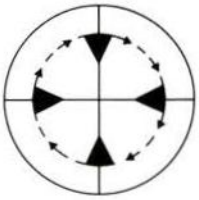


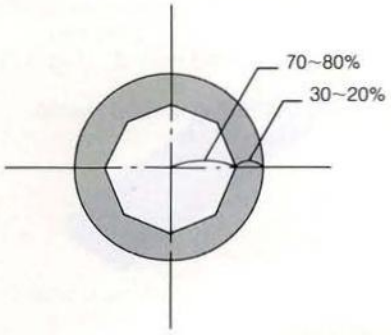
diagram e



## G. Use of Iris Diaphragms

When the top lens of the polarizing condenser is swung out for orthoscopic observation, the aperture iris diaphragm serves as a field iris diaphragm and the field iris diaphragm as an aperture iris diaphragm.

For conoscopic observation, generally the aperture iris diaphragm is fully opened and the field iris diaphragm can be effectively used for reduction of glare and conoscopic observation of very small objects.

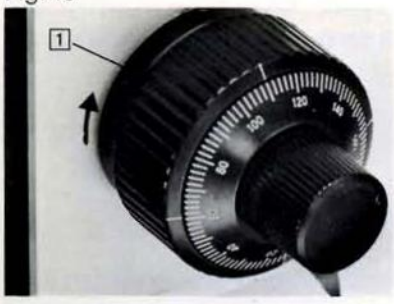



1. APERTURE IRIS DIAPHRAGM
   Adjust the opening of the aperture iris diaphragm according to the various conditions such as the numerical aperture of the objective, image contrast, depth of focus, and flatness of field. Generally it is often preferable to stop down the aperture iris diaphragm to about 70% or 80% of the N.A. of the objective.
   After the eyepiece is removed from the observation tube, if necessary, look through the observation tube and check the opening of the aperture diaphragm at the objective pupil.

2. FIELD IRIS DIAPHRAGM
   The field iris diaphragm controls the diameter of the ray bundle impinging on the specimen surface and thus increases image definition.
   Generally, it is preferable to slightly open the field iris diaphragm until it is just outside the field of view.

## H. Focus Adjustment

Fig. 15



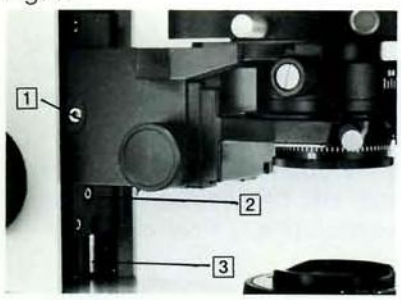

1. TENSION OF COARSE ADJUSTMENT KNOBS AND FINE ADJUSTMENT
   Although the tension of the coarse adjustment knobs has already been adjusted for optimum performance by the manufacturer, it is possible to adjust the tension of the coarse adjustment for either heavy or light movement depending on the operator's personal preference by rotating the tension adjustment ring 1 (Fig. 15) The ring can be rotated by inserting a screwdriver into one of the holes on the periphery of the ring. The clockwise rotation (in the direction of the arrow) tightens the coarse adjustment knobs. Do not loosen the ring too much, because the stage may drop or the fine adjustment knobs may slip.

   NOTE: Do not rotate the right and left coarse adjustment knobs in the opposite directions simultaneously. If the stage drops and the specimen goes out of focus, the tension adjustment ring is too loose. Tighten the ring.

Fig. 16

2. PRE-FOCUSING LEVER
   This lever 2 is provided to prevent possible contact between specimen and objective as well as to simplify coarse focusing. (Fig. 16) The lever is locked after coarse focus has been accomplished. This prevents further upward travel of the stage by means of the coarse adjustment knobs, and automatically provides a limiting stop if the stage is lowered and then raised again. The pre-focusing lever does not restrict fine focusing.

Fig. 17




3. ADJUSTMENT OF STAGE BLOCK HEIGHT
   In addition to the vertical movement of the stage by means of coarse and fine adjustments, the stage block height can be changed for observation of specimens which are thicker than standard slides. To lower the stage block:

   1) Loosen the stage block locking screw [1] with Allen wrench provided, and raise the stage block until the stopping screw [2] can be seen; then reclamp.

   2) Replace the stopping screw into the lower threaded hole [3]. (Fig. 17)

   3) Unclamping the stage block again, lower until it stops, and clamp.

**I. Use of Immersion Objectives**

1. Focus the specimen with a low power objective.
2. Put a drop of immersion oil on the specimen slide and the front lens of the immersion objective.
3. Turn the revolving nosepiece to bring the immersion objective into the light path, and focus with the fine adjustment knobs.

   NOTE:
   [1] Care should be taken to prevent oil bubbles from forming in the oil film. If this occurs, re-apply immersion oil, for these bubbles greatly deteriorate the lens performance.
   [2] After use carefully wipe off the immersion oil deposited on the lens surfaces with gauze moistened with xylene. Never leave oil on the lens surfaces after use as oil remnants will seriously impair the performance of the lens system.

**J. Orthoscopic Observation**

1. Swing out the top lens of the condenser. In principle, polarized light enters the light path, parallel to the optical axis, to enable observation of the optical characteristics of the specimen. However, this method will darken the field of view and lower the resolving power of the objective extremely. Therefore, swing out the top lens of the condenser, using only the lower aperture of the lower condenser lens (N.A. 0.25).
2. Insert the analyzer into the light path, and attain the crossed filter position with analyzer and polarizer at O setting. At this position, the polarizer vibration is in the X direction, and the analyzer vibration in the Y direction. To open the filter position, pull out the analyzer rotation screw.
3. Rotate the stage until the extinction of the image is attained.

   From this position, it is easy to rotate the stage slowly and to measure the retardation angle.

Sensitive tint plate
(optional)

Quarter wave plate
(optional)

Berek compensator
(optional)

4. Insert the quarter plate* or sensitive tint plate* into the slot, closest to you at your right hand side in the intermediate polarizing tube.
   To disengage the test plate, you can just pull it back to its click stop position (out position).

   ***A Berek compensator is optionally available to measure the birefringence of a specimen. A quarter wave plate and a sensitive tint plate are also optionally available.**

### K. Conoscopic Observation

1. Swing the top lens of the condenser (N.A. 0.9), and illuminate the specimen; there is no need to use immersion oil between the condenser and the specimen slide.
2. Bring the specimen into focus, rotate the Bertrand lens turret ring into the IN position.
3. Focus on the interference figure formed at the back focal plane of the objective from 20X to 100X (It is better to stop down the *field* iris diaphragm in case of very small objects.) The pinhole cap provided may be used in place of the eyepiece to directly view the interference figure mentioned above. In this case, the Bertrand lens is disengaged by turning it to the OUT position.

### L. Photomicrography

1. Photomicrographic equipment. Photomicrography with the Model BHTP requires photomicrographic equipment such as the photomicrographic system camera, exposure meter, photo eyepiece, etc. Read the instruction manuals for each equipment.
2. Photo eyepieces NFK3.3X and NFK5X are recommended for orthoscopic photomicrography, and NFK2.5X for conoscopic photomicrography.
3. Image magnification is obtained from the equation below: Objective magnification X NFK photo eyepiece magnification. = Total magnification on 35mm film.

# VI. OPTICAL DATA

| Objective | Type | PO D Ach. | | | | |
|---|---|---|---|---|---|---|
| | Magnification | 4X | 10X | 20X | 40X | 100X |
| | N.A. | 0.1 | 0.25 | 0.4 | 0.65 | 1.3 |
| | W.D. (mm) | 18.23 | 7.18 | 1.63 | 0.6 | 0.18 |
| | Focal length (mm) | 30.03 | 16.9 | 8.63 | 4.58 | 1.92 |
| Eyepiece | Resolving power (μ) | 3.36 | 1.34 | 0.84 | 0.52 | 0.26 |
| | Total magnification | 40X | 100X | 200X | 400X | 1000X |
| WHK10X | Focal depth (μ) | 172.5 | 27.6 | 9.14 | 3.0 | 0.65 |
| (Field number 20) | Field of view diameter (mm) | 5 | 2 | 1 | 0.5 | 0.1 |

| Objective | Type | PO D Plan | | | | |
|---|---|---|---|---|---|---|
| | Magnification | 4X | 10X | 20X | 40X | 100X |
| | N.A. | 0.1 | 0.25 | 0.4 | 0.65 | 1.25 |
| | W.D. (mm) | 7.03 | 7.4 | 0.83 | 0.23 | 0.17 |
| | Focal length (mm) | 34.23 | 17.5 | 8.99 | 4.67 | 1.75 |
| Eyepiece | Resolving power (μ) | 3.36 | 1.34 | 0.84 | 0.52 | 0.27 |
| | Total magnification | 40X | 100X | 200X | 400X | 1000X |
| WHK10X | Focal depth (μ) | 172.5 | 27.6 | 9.14 | 3.0 | 0.68 |
| (Field number 20) | Field of view diameter (mm) | 5 | 2 | 1 | 0.5 | 0.1 |

**Immersion objective. Highest resolving power is obtained when the objective is used at or near the full aperture diaphragm opening.**

□ W.D. (WORKING DISTANCE):
The distance between the specimen or cover glass and the nearest point of the objective.

□ N.A. (NUMERICAL APERTURE):
The numerical aperture represents a performance number which could be compared to the relative aperture (f-number) of a camera lens. N.A. values can be used for directly comparing the resolving powers of all types of objectives. The larger N.A., the better the resolving power.

□ RESOLVING POWER:
The ability of a lens to register small details. The resolving power of a lens is measured by its ability to separate two points lying close together in the field of view.

□ FOCAL DEPTH:
The distance between the upper and lower limits of sharpness in the image formed by an optical system in the image space.

□ FIELD NUMBER:
A number that represents the diameter in mm of the image of the field diaphragm that is formed by the lens in front of it.

□ FIELD OF VIEW DIAMETER:
The actual size of the field of view in mm.

□ FIELD DEPTH
The distance between the upper and lower limits of sharpness of focus in the object space as fine adjustment knob is turned.

# VII. TROUBLESHOOTING

If you are unable to obtain full performance from your microscope, please consult the table below as a guide for troubleshooting.

**1. Optical System**

| TROUBLES | CAUSES | REMEDIES |
|---|---|---|
| (a) With illuminator switched on, field of view cannot be seen. | Bertrand lens is engaged. | Disengage. |
| | Analyzer and polarizer are in "cross filter" position ("O:O"). | Disengage analyzer. |
| (b) Field of view is cut off or illuminated irregularly | Light path selector lever is stopped midway. (for trinocular tube) | Push in lever up to C.V. or V. |
| | Nosepiece is not clicked stopped. | Slightly rotate nosepiece until it clicks into position. |
| | Nosepiece is not correctly attached to stand. | Insert sliding dovetail mount into stand all the way, until it stops, then lock. |
| | Condenser is not correctly mounted on ring mount. | Re-insert condenser all the way. |
| | Test plate is stopped midway. | Push plate all the way until it clicks. |
| | In case of orthoscopic observation, condenser top lens stays in light path or stops midway. | Swing it out of light path. |
| | Field iris diaphragm is stopped down excessively. | Open field diaphragm fully until it just disappears from field of view. |
| | Lamp is not correctly attached. | Re-insert lamp correctly. |
| (c) Dust or dirt is visible in field of view. | Dust or dirt on glass surface at light exit on base. | Clean off dust or dirt by using a blower. |
| | Dust on condenser top lens. | |
| | Dirty specimen. | |
| | Dust on eyepiece. | |
| (d) Excessive image contrast. | Condenser is lowered excessively. | Raise condenser. |
| | Aperture iris diaphragm is stopped down excessively. | Open aperture diaphragm to 70-80% of objective lens filled with light. |
| (e) Resolution problems: | Nosepiece is not correctly attached. | Insert sliding dovetail mount all the way, until it stops, then lock. |
| □ Image is not sharp.<br>□ Insufficient contrast.<br>□ Image details lack definition | Objective is not correctly positioned in light path. | Slightly rotate nosepiece until it clicks into position. |
| | Dirt on objective front lens. | Clean objective. |
| | Immersion objective is used without immersion oil. | Apply immersion oil. |
| | Bubbles in immersion oil. | Remove bubbles. |
| | Olympus designated oil is not used. | Use designated oil. |
| | Dirty specimen. | Clean. |
| | Dirt on condenser lens. | |
| | Specimen is not properly illuminated. | Adjust illumination. Use Kohler type illumination. |

| 1. **Optical System** (continued) | | |
|---|---|---|
| TROUBLES | CAUSES | REMEDIES |
| (f) Field of view is partially out of focus. | Nosepiece is not correctly attached. | Insert sliding dovetail mount into stand all the way, then lock. |
| | Objective is not correctly positioned in light path. | Slightly rotate nosepiece until it clicks into position. |
| | Specimen is not correctly positioned on stage. | Place specimen on stage and secure it with specimen clips to hold it flat. |
| (g) Image goes out of focus eccentrically. | Nosepiece is not correctly attached. | Insert sliding dovetail mount all the way, until it stops, then lock. |
| | Objective is not correctly positioned in light path. | Slightly rotate nosepiece until it clicks into position. |
| | Condenser is out of center. | Center condenser. |
| (h) Light intensity does not increase although voltage is raised. | Condenser is not correctly centered. | Center condenser. |
| | Condenser is lowered excessively. | Raise condenser. |
| (i) No conoscopic image can be seen. | Condenser top lens is not in light path. | Swing it in. |
| (j) Crossed filter position is not attained. | Analyzer is out of light path. | Push it in. |

| 2. **Electrical System** | | |
|---|---|---|
| TROUBLES | CAUSES | REMEDIES |
| (a) Illuminator is too bright (or too dark). | Line voltage selector switch is not matched to the mains voltage. | Match selector switch with mains voltage. |
| | Mains voltage is too high (or too low). | Adjust mains voltage with a variable voltage transformer. |
| (b) Output voltage for illuminator cannot be regulated. | Voltage selector switch is not matched to mains voltage. | Adjust mains voltage selector switch to mains voltage. |
| | Mains voltage is too low or too high. | Adjust mains voltage with a variable voltage transformer. |
| (c) Lamp flickers and intensity is unstable. | Mains voltage is unstable. | Use a variable voltage transformer. |
| | Loose electrical connection. | Secure connection. |
| (d) Reduced bulb life. | Bulb is not a standard bulb. | Use a standard bulb. |

**3. Focusing**

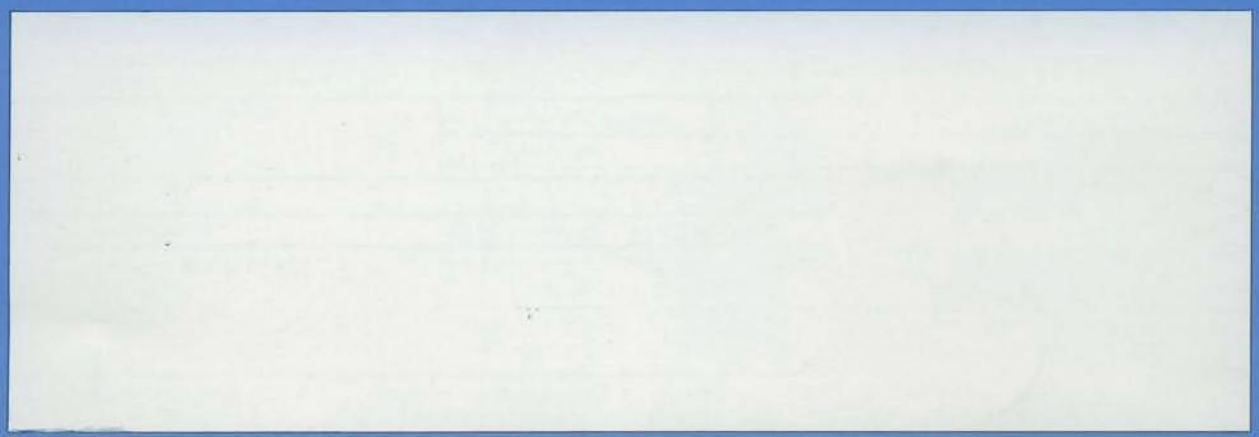
| TROUBLES | CAUSES | REMEDIES |
|---|---|---|
| (a) Coarse adjustment is too tight. | Tension adjustment ring is tightened too much. | Loosen tension adjustment ring properly. |
| | User is trying to raise stage passing over upper focusing limit imposed by engaged pre-focusing lever. | Unlock pre-focusing lever. |
| (b) Stage drops or specimen goes out of focus. | Tension adjustment ring is too loose. | Tighten ring properly. |
| (c) Stage cannot be raised to upper limit. | Pre-focusing lever is engaged in lower than focusing position. | Unlock pre-focusing lever. |
| (d) Stage cannot be lowered to lower limit of working range. | Condenser mount is lowered too much. | Raise condenser mount. |
| (e) Objective front lens hits against specimen slide. | specimen is mounted on stage upside down. | Turn slide right side up. |

**4. Observation Tube**

| TROUBLES | CAUSES | REMEDIES |
|---|---|---|
| (a) Incomplete binocular vision. | Interpupillary distance is not correctly adjusted. | Adjust interpupillary distance. |
| | Diopter adjustment is incomplete. | Complete diopter adjustment on left eyepiece tube. |
| | Right and left eyepieces are not matched. | Use a pair of matched eyepieces. |
| | User is unaccustomed to binocular vision. | Prior to looking at the image of specimen, try to look at entire field of view, or look at a far away object before resuming microscopic observation. |

**5. Stage**

| TROUBLES | CAUSES | REMEDIES |
|---|---|---|
| (a) Image easily goes out of focus when you touch stage. | Stage is not correctly clamped. | Clamp stage securely. |
| (b) Specimen stops midway on the X or Y traverse. | Specimen is not correctly positioned on stage. | Adjust specimen position. |
| (c) When stage is rotated, image of specimen goes out of field of view. | Stage is not centered or objective is not. | Center the stage; then center the objective if necessary. |



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